

Epidural Analgesia in High-Risk Obstetric Patients: A Prospective Observational Study

Pushkal Yadav¹, Anjali Kumari², Santosh Priya³, Rajesh Verma⁴

¹Senior Resident, Department of Anaesthesia, PMCH, Patna, Bihar, India

²Senior Resident, Department of Anaesthesia, PMCH, Patna, Bihar, India

³Senior Resident, Department of Anesthesia, PMCH, Patna, Bihar, India

⁴Professor, Department of Anaesthesia, PMCH, Patna, Bihar, India

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Corresponding Author: Anjali Kumari

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Abstract:

Background: Labor pain induces significant maternal stress, which can adversely affect both the mother and fetus, particularly in high-risk obstetric patients. Epidural analgesia is considered the gold standard for labor analgesia, offering effective pain relief with minimal systemic effects.

Aim: To evaluate the effectiveness, maternal hemodynamic stability, and safety of epidural analgesia in high-risk obstetric patients.

Methods: This prospective observational study included 100 high-risk parturients who received epidural labor analgesia. Pain scores, maternal hemodynamic parameters, mode of delivery, neonatal outcomes, and complications were recorded and analyzed.

Results: Adequate analgesia was achieved in 85% of patients. Maternal hemodynamics remained stable throughout labor. The majority of patients had successful vaginal deliveries, and neonatal outcomes were favorable with minimal complications.

Conclusion: Epidural analgesia provides effective and safe pain relief in high-risk obstetric patients, with good maternal and neonatal outcomes.

Keywords: Epidural Analgesia, High-Risk Pregnancy, Labor Pain, Obstetric Anesthesia.

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Introduction

Labour pain is regarded as one of the most severe types of pain seen by women, accompanied by considerable physiological stress responses. These encompass tachycardia, hypertension, hyperventilation, and elevated oxygen consumption, all of which may negatively impact maternal and foetal health. Specifically, these stress reactions may impair uteroplacental perfusion, potentially resulting in foetal hypoxia, particularly in high-risk pregnancies [1].

Obstetric patients at high risk, including those with pregnancy-induced hypertension, heart illness, anaemia, diabetes mellitus, and advanced maternal age, are more susceptible to these harmful effects. Effective pain management in these individuals is crucial for both maternal comfort and the enhancement of foetal outcomes. The selection of analgesic approach must be meticulously evaluated to prevent hemodynamic instability and other problems [2].

Epidural analgesia has become one of the most efficacious and prevalent techniques for alleviating labour pain. It delivers superior segmental analgesia

by inhibiting nerve conduction at the spinal level, so markedly diminishing pain perception without inducing total motor blockade. Epidural analgesia significantly mitigates the maternal stress response, resulting in enhanced hemodynamic stability and increased uteroplacental blood flow [3].

Epidural analgesia provides flexibility in anaesthetic management, allowing for extension during operational procedures such as instrumental birth or caesarean section when necessary. Considering these advantages, it is especially advantageous for high-risk obstetric patients.

This study seeks to assess the efficacy and safety profile of epidural analgesia in high-risk obstetric patients, concentrating on maternal hemodynamic stability, pain alleviation, and overall outcomes.

Materials and Methods

Study Design: Prospective observational study.

Study Place and Duration: The study was carried out at PMCH, Patna, Bihar between March to September 2025.

Study Population

- **Sample size:** 100 parturients
- **Age:** 18–40 years
- **Gestational age:** ≥ 37 weeks
- **High-risk conditions:** PIH, gestational diabetes, anemia, cardiac disease, previous cesarean section, elderly gravida

Study group: Fentanyl-0.125% (loading), 0.1% (maintenance)

Bupivacaine-2 $\mu\text{g/mL}$

Inclusion Criteria

- Singleton pregnancy
- Active labor
- Consent for epidural analgesia

Exclusion Criteria

- Coagulopathy
- Infection at epidural site
- Patient refusal
- Severe fetal distress

Technique: Epidural analgesia was administered using standard aseptic precautions at the L2–L3 or L3–L4 interspace. A test dose followed by incremental doses of low-concentration local anesthetic with opioid was given.

Parameters Assessed

- Pain score (VAS)
- Maternal heart rate and blood pressure
- Mode of delivery
- Neonatal APGAR scores
- Maternal and fetal complications

Results**Table 1: Demographic and Clinical Characteristics**

Parameter	Value
Mean age (years)	28.6 \pm 4.2
Primigravida	58%
Multigravida	42%
PIH	35%
Gestational diabetes	22%
Anemia	18%
Cardiac disease	10%
Other risk factors	15%

Table 2: Effectiveness of Epidural Analgesia

Outcome	Number of Patients (n=100)
Adequate analgesia	85
Inadequate analgesia	15
Hemodynamic instability	6
Instrumental delivery	12
Cesarean section	18

Table 3: Neonatal Outcome

Parameter	Observation
Mean APGAR at 1 min	7.8 \pm 0.6
Mean APGAR at 5 min	9.1 \pm 0.4
NICU admission	6%

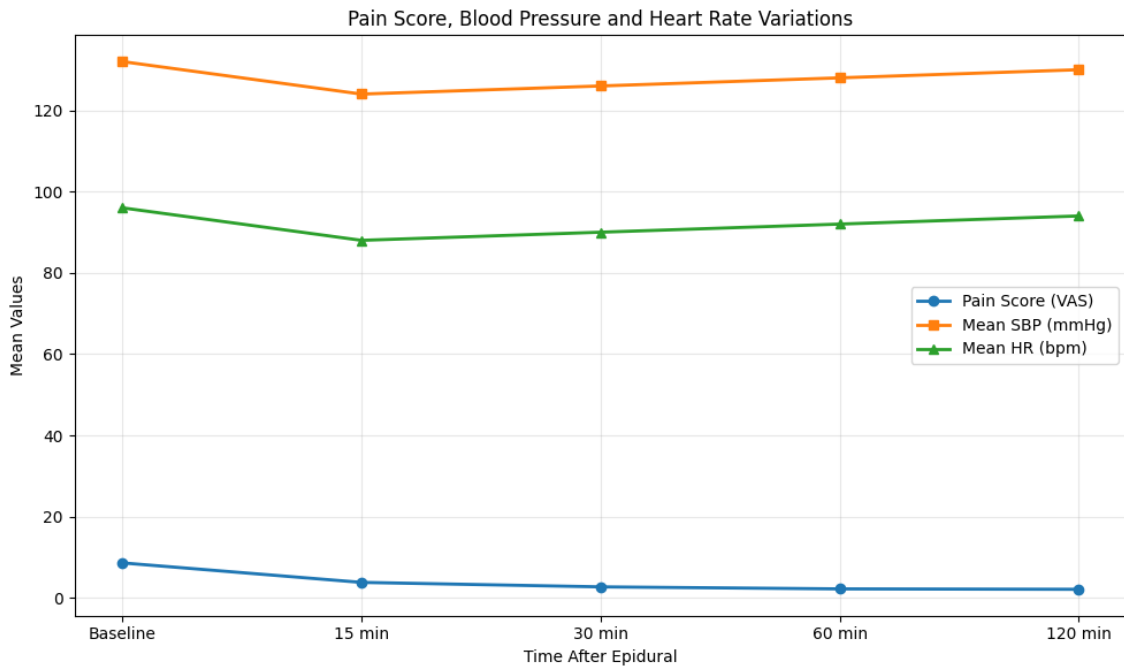


Figure 1: Pain score, BP, HRV

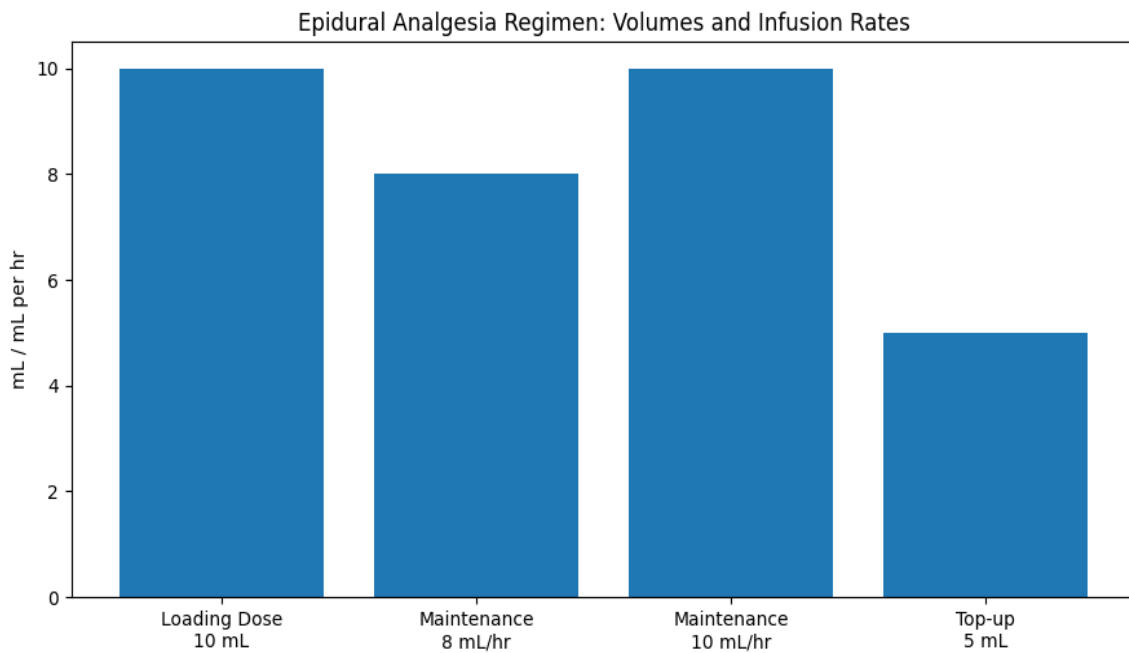


Figure 2: Epidural analgesia drug volume and infusion parameters

Table 4: Drug Classification Based on Epidural Analgesia Regimen

Drug	Class	Mechanism of Action	Concentration Used	Role in Labour Epidural
Bupivacaine	Long-acting amide local anesthetic	Blocks voltage-gated sodium channels and inhibits nerve impulse conduction	0.125% (loading), 0.1% (maintenance)	Provides sensory analgesia with minimal motor block
Fentanyl	Opioid analgesic (μ -receptor agonist)	Acts on opioid receptors in spinal cord and CNS to reduce pain transmission	2 μ g/mL	Enhances analgesia, reduces local anesthetic dose requirement

Table 5: Combination Classification

Regimen	Classification	Purpose
Bupivacaine + Fentanyl	Combined local anesthetic–opioid epidural mixture	Synergistic analgesia with improved pain relief and better hemodynamic stability

Discussion

This prospective observational study indicates that epidural analgesia offers effective and dependable pain treatment for most high-risk obstetric patients. Adequate analgesia was attained in 85% of instances, aligning with prior research that indicate elevated success rates of epidural labour analgesia. This underscores its efficacy as a favoured approach for alleviating labour pain, especially in patients with concurrent medical problems. A significant discovery of this study is the preservation of maternal hemodynamic stability in the majority of patients. A small percentage suffered hypotension, which was often mild and temporary, responding effectively to routine management interventions such as fluid administration and vasopressors. This is especially pertinent in high-risk obstetric patients, where sustaining stable hemodynamics is essential for ensuring appropriate uteroplacental perfusion and foetal oxygenation [4].

The current study shows that an epidural analgesia regimen utilising fentanyl and bupivacaine produced favourable maternal hemodynamic stability and efficient labour analgesia. The significant decrease in pain scores following epidural administration indicates that the loading dose of 10 mL of 0.125% bupivacaine with fentanyl 2 µg/mL generated a rapid start of analgesia. The effectiveness of the medication combination was confirmed by the significant decrease in mean visual analogue scale (VAS) scores from baseline severe pain levels to mild pain levels in a little amount of time. Analgesia was successfully maintained throughout labour with a maintenance regimen of 0.1% bupivacaine with fentanyl 2 µg/mL at 8–10 mL/hr or sporadic 5 mL top-ups. While maintaining the mother's capacity to actively participate in the second stage of labour, the use of a lower maintenance concentration probably reduced motor blockage. This result is in line with the preference for diluted local anesthetic-opioid mixes in contemporary obstetric anaesthesia practice [4].

Epidural anaesthesia has a major impact on the outcomes for both mothers and newborns and is frequently used to relieve discomfort during birth. By significantly lowering pain intensity as determined by the Visual Analogue Scale (VAS), it offers excellent analgesia and enhances mother comfort and satisfaction during labour [5]. However, because epidural analgesia reduces the mother's bearing-down efforts, it may prolong the second stage of labour, increasing the likelihood of artificial deliveries like forceps or vacuum-assisted births.

Recent research indicates that these effects have been reduced by contemporary low-dose epidural procedures, despite this relationship [6].

In terms of neonatal outcomes, neonatal Apgar ratings at 1 and 5 minutes are often unaffected by epidural anaesthesia, suggesting minimal foetal depression and preserved neonatal well-being. Hypotension, urine retention, shivering, fever, and, in rare cases, post-dural puncture headache are all possible consequences for mothers [7]. Although they are rare, foetal problems can include temporary foetal heart rate variability brought on by maternal hypotension. Overall, when used with proper monitoring and multidisciplinary obstetric care, epidural anaesthesia is still a safe and efficient technique for labour analgesia [8].

Over the course of the monitoring period, hemodynamic parameters stayed comparatively constant. Heart rate and mean systolic blood pressure only slightly decreased from baseline before gradually returning to pre-epidural levels. These alterations were clinically well tolerated and were anticipated as a result of sympathetic blocking. In high-risk obstetric patients, stable cardiovascular measures are especially crucial since significant changes may jeopardise uteroplacental perfusion. Effective analgesic use was suggested by the permissible mean total medication volume utilised during labour [9]. Overall, the findings show that this epidural regimen is a safe and appropriate choice for labour analgesia since it provides the best possible balance of realistic dose requirements, little hemodynamic disruption, and adequate pain management. The study showed a low occurrence of unfavourable neonatal outcomes, indicating that epidural analgesia does not adversely affect foetal well-being. Epidural analgesia may indirectly enhance foetal outcomes by alleviating maternal stress reactions, including tachycardia and hypertension [10].

A notable benefit of epidural analgesia is its adaptability. It facilitates the swift augmentation of anaesthesia if surgical procedures, such as instrumental birth or caesarean section, are required. This is particularly advantageous in high-risk pregnancies because the probability of surgical delivery is elevated. These data endorse epidural analgesia as a secure, effective, and adaptable method for pain treatment in high-risk obstetric patients

Conclusion

Epidural analgesia is a safe and effective method of labor analgesia in high-risk obstetric patients. It provides excellent pain relief, maintains maternal hemodynamic stability, and is associated with favorable neonatal outcomes. Epidural analgesia should be encouraged as the analgesic technique of choice in high-risk obstetrics.

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